ties were consulted to determine the desirability of proposed alternatives. The alternatives were compared by adding the individual ranking for a score through the suggested procedure. The exclusive use of small shuttle buses to provide transportation service between the mouth of the canyon and the ski resorts was found to be relatively more attractive on the basis of economic factors and community responses.

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Impact of Population and Energy on Transportation Needs: Multimodal Approach

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This paper documents a computer process developed to explore the potential diversion of automobile trips by purpose and length for various population growths and energy futures and the impact this diversion will have on transportation needs. The technique is a straightforward method of using the existing statewide transportation model to generate statewide highway trip tables for each possible future. These tables are split by trip purpose based on analysis of actual statewide origin-destination data and then split into modes based on trip purpose and length information gained in the survey of air, rail, and bus travel characteristics. Information on the modal split in other mass transit corridors in the United States is also used as a guide. The variables in this process are easily understood and thus may be quickly adjusted to reevaluate transportation needs and to reflect various planning policies. Once the modal trip tables are generated, they are assigned to a statewide air, rail, or bus network based on station accessibility; the remaining trips are assigned to the highway network. The end product is a computer plot that shows the potential travel volumes by mode and the probable impact of each population growth and energy future on state highway needs. This technique is being applied in rural portions of 13 of Michigan's 14 planning regions.

Determination of which highway construction projects are necessary and establishment of priorities requires analysis of numerous alternatives. Since planners must be aware of potential changes in social and economic conditions, a process of measuring the impact of these changes on travel patterns and demands must be developed to identify critical deficiencies and to evaluate various construction programs.

Recent federal legislation, increased public involvement, and changes in social and economic problems have created many new issues that must be resolved by transportation agencies. The Federal-Aid Highway Program Manual (1) states, "It is the FHWA's [Federal Highway Administration's] policy that... appropriate consideration be given to reasonable alternatives, including the alternative of not building the project and alternative modes." It further states that an action plan should identify procedures to be followed to ensure that "... alternatives containing new transportation modes or improvements to existing modes are adequately considered, where appropriate."

Many alternate transportation modes suffer due to population dispersion and erratic public response; but recent public emphasis on energy conservation may cause future travel patterns and demands to change. Consequently, in order to forecast future transportation needs, a transportation planner must be able to estimate population growth rates and identify major areas of change. It has, therefore, become imperative for transportation agencies to consider the effects and interaction of at least three major influences on travel patterns:

1. The related effects of energy availability and cost,
2. The increased emphasis on alternative modes, and
3. A growing and potentially shifting population.

The problem of defining future transportation needs

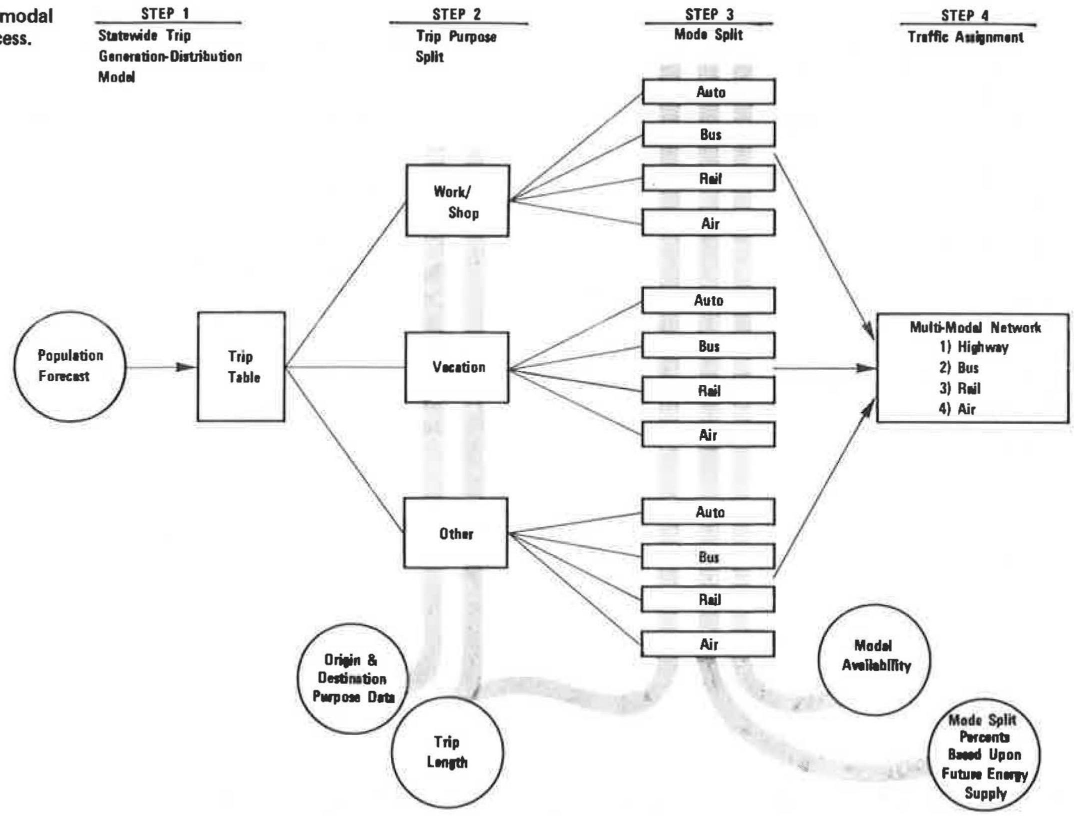


Figure 1. Multimodal assignment process.

and deficiencies is further complicated by the interaction between energy costs, population shifts and growth, and the accessibility of alternative modes. Until recently, addressing all of these issues and their resulting impact on travel effectively has been difficult. Now, Michigan's Bureau of Transportation Planning has developed a process that combines origin and destination information and existing statewide traffic forecasting model tools to measure these impacts and to aid in a number of different planning activities.

The various steps that are performed by this new multimodal process are shown in Figure 1. The analysis begins with future highway trip tables produced by the existing statewide transportation modeling system for selected projected populations. The trip length and the purpose data derived from approximately 70 actual origin and destination studies are then used to divide the trip tables by purpose. A summary for the northwest region (region 10) follows:

Trip Purpose	Average Trip Length (min)	Total Trips (%)
Work	31	36
Personal business	29	8
Shopping	23	20
Vacation	92	7
Social-recreational	31	19
Other	26	10

The trip purpose tables are then divided by mode, using statewide and national mode split information and additional bus, rail, and air origin and destination data. Modal split data from the northeast corridor of the United States were also used as reference material. These mode split percentages vary to reflect expected modal usages for each selected future energy condition. The modal split process is selective in that trip purpose and length and modal accessibility are determined before any trip is assigned to a particular mode. Therefore, the resulting link volumes display the sensitivity of different types of trips to any given energy condition as reflected through various modal splits and the related impact on highway deficiencies under differing transportation plans.

TOTAL TRIP TABLE GENERATION

The state of Michigan and contiguous areas outside of the state are divided into 547 zones. Zone sizes and boundaries were determined on the basis of population, land area, and political boundaries.

The initial total trip table is generated by the existing statewide transportation modeling system and simulates future travel between these 547 zones. Zonal population forecasts are used to develop this table. In this report, the generated total trip tables represent a year 2000 forecast. Three different population forecasts are used to simulate travel for high-, medium-, or low-growth futures. Although these trip tables are derived from highway-oriented data, they are assumed to represent all travel generated by all modes because the current bus, train, and air data reveal that these modes contribute only a very small percentage of total intercity passenger travel in Michigan.

Division of Total Trip Table by Trip Purpose

The objective of this process was to explore the potential diversion to other modes of various automobile trip purposes for various futures and the impact the diversion would have on transportation needs and deficiencies. A common concern expressed is that certain trips, like vacation trips, will not be good candidates for public transportation. However, other trips, like work trips, because of generally low vehicle occupancy and short travel distance, could become potential transit trips.

Table 1. Estimated modal split by trip length, trip purpose, and energy future.

Energy Future	Trip Purpose	Travel Reduction (%)	Mode	Trip Length (min)[a] 0-30	31-60	61-90	91-120	121-300	300+
Abundant	Work	0	Automobile	99.9	99.6	98.6	97.0	94.6	88.8
			Bus	0.1	0.2	0.6	1.0	2.0	2.0
			Rail	0.0	0.2	0.8	2.0	2.0	2.0
			Air	0.0	0.0	0.0	0.0	1.4	7.2
	Vacation	0	Automobile	99.9	99.6	98.6	97.0	96.2	90.1
			Bus	0.1	0.2	0.6	1.0	2.0	2.0
			Rail	0.0	0.2	0.8	2.0	1.0	1.5
			Air	0.0	0.0	0.0	0.0	1.0	6.4
	Other	0	Automobile	99.9	99.6	98.6	97.0	94.7	88.7
			Bus	0.1	0.2	0.6	1.0	2.0	2.0
			Rail	0.0	0.2	0.8	2.0	2.5	2.5
			Air	0.0	0.0	0.0	0.0	0.8	6.8
Conserved	Work	0	Automobile	93.0[b]	93.0[c]	97.0	94.0	91.0	84.0
			Bus	5.0	2.0	1.0	2.0	4.0	4.0
			Rail	0.0	0.0	2.0	4.0	4.0	4.0
			Air	0.0	0.0	0.0	0.0	1.0	8.0
	Vacation	5	Automobile	100.0	99.0	97.0	96.0	93.0	87.0
			Bus	0.0	1.0	1.0	2.0	4.0	4.0
			Rail	0.0	0.0	2.0	2.0	2.0	2.0
			Air	0.0	0.0	0.0	0.0	1.0	7.0
	Other	5	Automobile	95.0	99.0	97.0	93.0	90.0	84.0
			Bus	5.0	1.0	1.0	3.0	4.0	4.0
			Rail	0.0	0.0	2.0	4.0	5.0	5.0
			Air	0.0	0.0	0.0	0.0	1.0	7.0
Restricted	Work	0	Automobile	85.0[c]	84.0[d]	97.0	93.0	87.0	81.0
			Bus	10.0	5.0	1.0	3.0	5.0	5.0
			Rail	0.0	1.0	2.0	4.0	7.0	7.0
			Air	0.0	0.0	0.0	0.0	1.0	7.0
	Vacation	20	Automobile	100.0	98.0	97.0	94.0	90.0	84.0
			Bus	0.0	1.0	1.0	3.0	4.0	4.0
			Rail	0.0	1.0	2.0	3.0	5.0	6.0
			Air	0.0	0.0	0.0	0.0	1.0	6.0
	Other	20	Automobile	90.0	95.0	97.0	91.0	85.0	78.0
			Bus	10.0	4.0	1.0	4.0	6.0	6.0
			Rail	0.0	1.0	2.0	5.0	8.0	10.0
			Air	0.0	0.0	0.0	0.0	1.0	6.0

[a] Based on approximate automobile driving time.
[b] Includes 2 percent shift to carpools.
[c] Includes 5 percent shift to carpools.
[d] Includes 10 percent shift to carpools.

The previous statewide transportation modeling system generated only total travel and could not be used to assess potential diversion from the automobile by purpose. Therefore, additional information about actual trip purpose and length was obtained from various origin and destination surveys. Analysis of the major and minor origin and destination surveys was subsequently performed for all terminal trips and the results were evaluated by the northwest regional planning team. Trip purposes were summarized into three typical categories: work, vacation, and other. Driving time was used as a measure to group the trip length categories. The final derived percentages by some of the categories are as follows:

Trip Length	Work (%)	Vacation (%)	Other (%)
0-30 min	60	0	40
61-120 min	59	7	34
181-240 min	50	21	29
300+ min	35	40	25
All travel	60	2	38

Vacation trips represent only 2 percent of the total travel. Normally, this would not warrant a separate trip purpose for analysis. But in Michigan vacation travel is significant on many roads because of the trip length. Therefore, vacation trips were considered separately. Also, vacation travel may account for 30-40 percent of the trips generated from the heavily populated Chicago zones destined for Detroit zones. Vacation trip percentages increase as the trip length increases, and work trip percentages decrease as the trip length increases. This relation between a trip's purpose and length is an important travel characteristic and was considered in the development of the statewide modal split percentages used in the analysis process.

The present statewide model uses average daily traffic (ADT) volumes in travel impact analysis. The multimodal analysis process developed in Michigan uses person trips; therefore, vehicle trips were converted to person trips by use of average vehicle occupancy rates for the various trip purposes, which were obtained from actual origin and destination data. Occupancy figures averaged 1.61 for work trips, 3.15 for vacation trips, and 2.19 for all other trips surveyed in Michigan.

Modal Split of Trip Purpose Trip Tables

The process described is intended to show a simulated traffic assignment by mode for selected population and energy futures. Once a total trip table is divided into the various trip purposes for a selected population projection, it then becomes necessary to analyze potential modal use by trip purpose and length. The traffic mode split must also be dependent on the energy future being considered. Probable modal split percentages were derived for abundant-, conserved-, and restricted-energy futures. The mode split for the abundant-energy future favors automobile travel; the restricted- and conserved-energy futures show an increased use of other transportation modes. Table 1 shows the modal split percentages by energy future that were used for the northwest regional study (2). The figures are intended to represent estimates of the possible modal selections derived after examination of national, state, and Northeast Corridor modal data and experiences and are not based on an extensive modal split model. Although several energy and transportation related studies have been conducted, there is not a consensus of opinion about the probable use of alternative transportation modes in an energy-deficient future. Trips assigned to alternative transportation modes based on the modal split percentages were further examined to determine the feasibility of that mode. If the access and egress time to the other mode was excessive in comparison to total automobile travel time, the trip was returned to the automobile trip table. Access and egress time includes a 20-min wait period at both origin and destination stations. This eliminates short-distance trips. Thus, a computer process was developed that would be flexible enough to assume any desired modal split assumption. Experience indicates that use of three energy futures; three population growth futures; modal accessibility measures; and the trip purpose, trip length, and vehicle occupancy data provide the desired flexibility and sensitivity. A few observations about Table 1 follow.

Abundant-Energy Modal Split Percentages

Since this energy future is expected to simulate present travel habits, some modal split data are available. A 1972 National Travel Survey (3) for passenger travel and a 1975 General Aviation Activity Survey (4) for trips over 160 km (100 miles) in length were used to obtain some of the modal split percentages. Information on trips shorter than 160 km in length was not readily available, so a modal split percentage that reflects a dominance of automobile travel was selected for these trips. Air and rail modes did not warrant consideration for the shorter trips regardless of purpose, and the percentage of trips to be diverted to bus was based on present travel patterns.

Conserved-Energy Modal Split Percentages

The basic strategy used to develop modal split tables for the conserved- and restricted-energy futures focuses attention on the short-distance work trip. This trip is considered the most likely candidate for transit use in an energy-short future. For the conserved-energy future, 5 percent of the automobile trips were diverted to bus. This 5 percent applies only to the 0- to 30-min work trip. Because carpooling is likely to increase as energy costs rise, the short work trips for the conserved- and restricted-energy futures decrease by 2-5 percent. The respective modal split percentages are fairly consistent with those for the abundant-energy table for the other trip-length categories.

The vacation trip is not considered a potential transit trip because of its high vehicle occupancy. Therefore, the automobile mode continues to dominate this trip purpose for the conserved-energy future. The other trip purpose category has features common to the work and vacation trips, so some diversion to alternative modes is indicated. Within this trip category are recreation and social trips. Charter buses are already used for some long-distance weekend trips. In an energy-short future, one would expect an even greater percentage of this kind of trip to use alternative modes, despite a possible reduction in the actual number of trips. These possibilities are reflected in the modal split percentages. Short-distance social trips may also shift to other modes, especially in urban areas where improved transit services would already be available. The air and rail modes are a relatively small percentage of total travel for this future. Also note that, for the vacation and other trip purposes, trips were reduced by 5 percent before the modal split to reflect an increased tendency to consolidate and eliminate some of these trips.

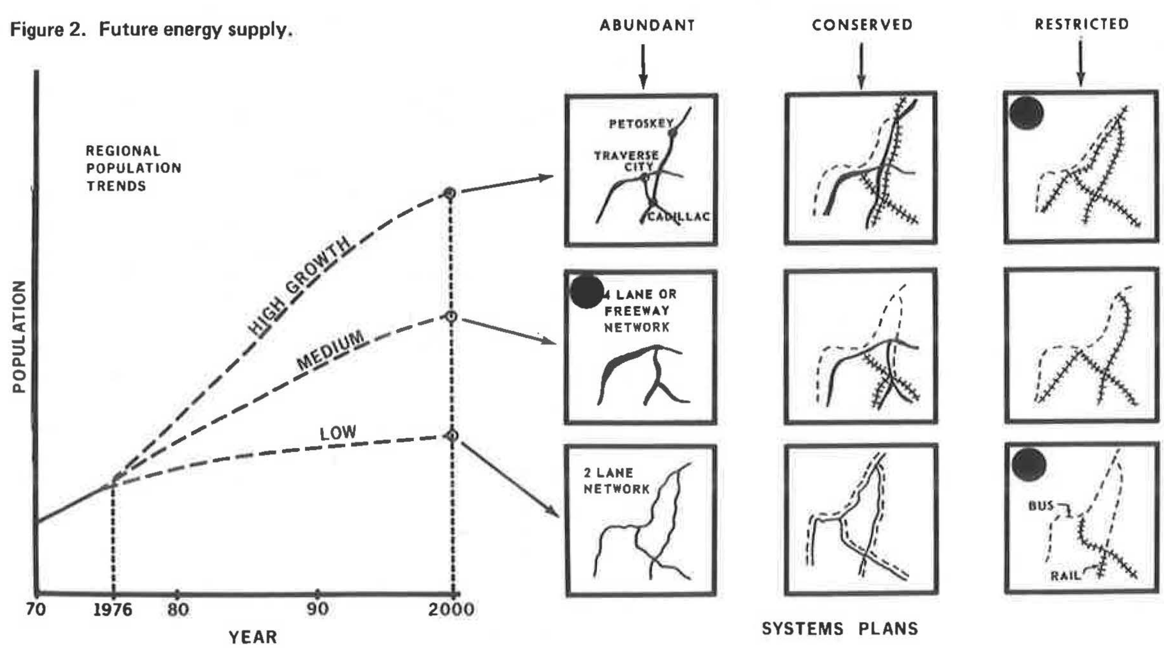
Restricted-Energy Modal Split Percentages

For the restricted-energy future, the modal split percentages show a 10 percent diversion from automobiles for the short-distance work trip as well as a 5 percent shift to carpools or vanpools for the short work trips and a 10 percent shift for 31- to 60-min work trips. Bus and rail traffic increases, and air travel begins to decrease slightly. This prediction is debatable since few data are available to support any assumptions about air travel. For the restricted-energy future, a 20 percent travel reduction factor is applied to the vacation and other trip categories to indicate a greater reluctance to travel as costs grow.

TRAFFIC ASSIGNMENT BY MODE

The traffic assignment portion of this process uses essentially the same techniques as incorporated into the existing statewide highway model. The air and rail net-

Figure 2. Future energy supply.



work plots were reviewed by their respective modal planning sections; and, with this addition to the existing highway network, intermodal assignments were then generated.

The basic traffic assignments follow the minimum time paths for each modal network. The potential bus network is assumed to be equivalent to the highway network since any highway corridor that shows great bus passenger potential could easily become a bus route. At this time, private ownership and operation of bus, rail, and air modes are not incorporated into the analysis. These considerations are important for current project planning activities; however, the potential exists for increased state subsidy of private operations, especially in northern Michigan. Therefore, some systems analysis is appropriate within these constraints and should be beneficial to the project planning phase.

NORTHWEST REGION APPLICATION

Michigan's northwest regional planners recently made use of the multimodal process to assist in development of regional systems plans. The application of this process requires one to select and define probable futures of population growth, energy availability, and cost. Since each future must be evaluated for each of four travel modes, it is advantageous to select only a few futures. For the northwest region, nine such futures were selected, based on three possible population growth trends and three possible energy situations. These futures and some generalized systems plans derived from the multimodal process for the northwest region are displayed in Figure 2. The purpose and modal split ratios discussed earlier were used for this study. The three futures selected for detailed comparison in this report are indicated in Figure 2 by large dots. A plot for each travel mode per future is required to display the projected assignments adequately. Figure 3 shows a simplified example of such plots and depicts the area around Cadillac and Traverse City. This area contains roads that are used extensively for long-distance vacation trips (such as US-131) county roads used mainly for local travel, and state trunklines (such as MI-55), which mainly serve regional travel. Note that, because the splits by trip purpose depend on trip length, the assignments reflect a sensitivity to these different road characteristics.

The plots in Figure 3 contain four numbers on each link. The first number is the number of work trips assigned, the second is the number of vacation trips, the third is the number of other-purpose trips, and the last number on every link is the total trip assignment. The 547-zone system is too coarse to adequately predict local traffic, especially in urban areas and on local roads. Nevertheless, some interesting aspects of this multimodal method may be displayed by comparison of assignments on various types of roads. Figure 3 shows some assignments for the medium population growth with an abundant-energy future. Table 2 summarizes the assignments on the links indicated by the numbered arrows in Figure 3.

These assignments confirm expectations based on the known travel characteristics for each of these roads. For instance, travel on US-31 drops rapidly as one travels north from Traverse City. In the abundant-energy, medium-population future, work and shopping travel on US-31 is 56.7 percent of its total assignment, compared to 8.6 percent for vacation travel. On US-131, 44.8 percent of the assigned trips are work-shopping trips and 26.4 percent are vacation trips, which strongly supports actual origin and destination studies of vacation travel on US-131. The logical pattern for vacation trips is also evident on MI-55; vacation travel is 7.8 percent, but only 2.2 percent of the travel on Alden Highway (a county road in southern Antrim County) is vacation travel. The fluctuation in work-shopping, vacation, and other purpose percentages by individual road types may be compared to the statewide percentages of 60 percent work and shopping, 2 percent vacation, and 38 percent other for all three abundant-energy futures, as shown in Table 3. The strong vacation attraction of the northwest region is clearly reflected in the assignments, which show that even local roads are above average in the ratio of vacation trips to total trips.

Table 3 also displays the statewide effects of various energy futures. One notes that in the conserved-energy future and the abundant-energy future each of the trip purposes is affected about equally. Trips by all purposes decrease, but the other-purpose trips decrease most. Only in the restricted-energy futures does trip purpose seem to play a significant role—vacation and other trip purposes decrease considerably faster than do work trips. This reflects the assumptions expressed in the modal split percentages (Table 1), where the 5 and 10 percent travel reduction factors were applied for the conserved- and restricted-energy futures, respectively, for both vacation and other trip purposes. Work-shopping trips were also reduced somewhat to include possible shifts to carpools for short-distance trips.

Table 2 shows that total automobile travel in the restricted-energy, high-population-growth future drops compared to the abundant-energy, medium-population-growth future for each of the five links studied. However, work-shopping trips increase on the US-31 and US-131 links, and vacation and other-purpose trips drop considerably. Work-shopping trips show the same reluctance to drop on Alden Highway and MI-55. Thus, one could infer that roads that have a high percentage of work and shopping trips will be least affected by rising energy costs, regardless of the rate of population growth. This may be confirmed by comparison of the assignments for the restricted-energy, low-population-growth future with the abundant-energy, medium-population-growth future.

Table 3 shows that the low-population-growth future generates 91.7 percent as many trips as the high-population-growth future. However, when one examines the assignments in Table 2 for the restricted futures, one finds a ratio near 75 percent on all links except MI-55, which has a ratio of 93.7 percent. The other factors of trip purpose, trip length, and modal accessibility cause this ratio to fluctuate as road usage changes. The US-31 and US-131 assignments are well above the average 9 percent increase between low- and high-population growths; however, the predicted change in travel on MI-55 is slightly less than might be expected based on the statewide average. More detailed analysis will have to be done to fully explain these fluctuations in travel growth, but a few assumptions might be made. Of the five links listed in Table 2, MI-55 is the only link likely to serve mainly average-distance trips. Referring back to the mode split ratio (Table 1), one sees that trips between 30 and 120 min in length are considered least apt to select another travel mode. Another special feature of the MI-55 link is that it is the only link not likely to serve trips between Cadillac, Traverse City, and other major cities. It is also an east-west route; the major traffic movement in this region is north-south. Since most population growth would occur around major cities, particularly southern Michigan cities, this growth will probably affect MI-55 the least of any of the five links.

The preceding paragraphs help verify that this multimodal process is sensitive to energy costs, population growth, road use, and trip characteristics. The planning assumptions concerning the various energy futures are reflected by the assignments in varying degrees, de-

Figure 3. Modal plots, medium population growth, and abundant-energy future.

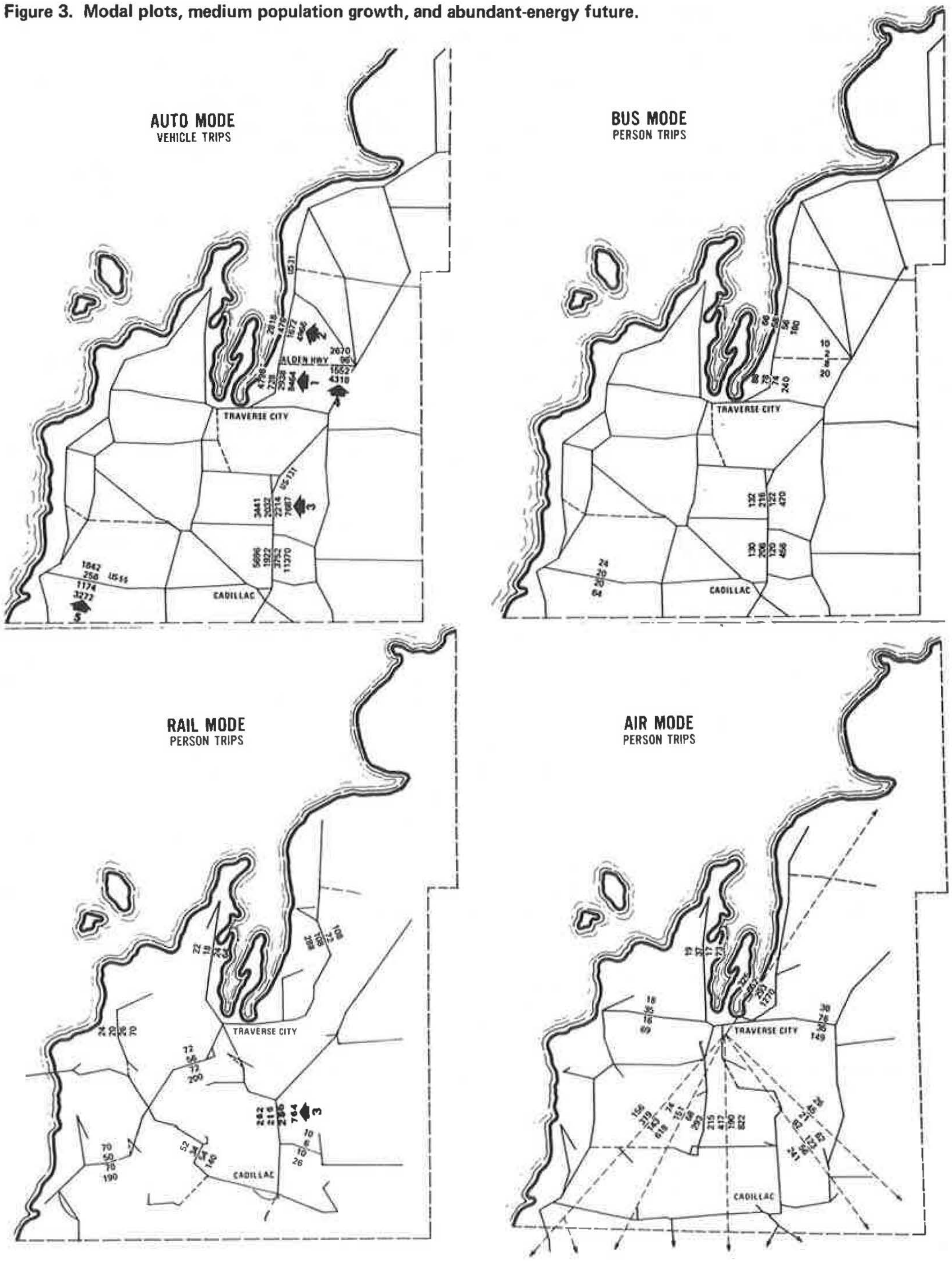


Table 2. Highway assignments on selected links.

Energy Future	Trip Purpose	US-31 (South)	US-31 (North)	US-131	Alden Highway	MI-55
Abundant—medium population	Work-shopping	4798	2818	3441	2670	1842
	Vacation	728	478	2032	96	256
	Other	2938	1672	2214	1552	1174
	Total	8464	4968	7687	4318	3272
Restricted—low population	Work-shopping	3598	2126	2734	1932	1554
	Vacation	490	320	1386	64	182
	Other	1868	1082	1418	1012	824
	Total	5956	3528	5538	3008	2560
Restricted—high population	Work-shopping	4940	2852	3562	2538	1660
	Vacation	612	404	1640	86	200
	Other	2566	1450	1834	1328	872
	Total	8118	4706	7036	3952	2732

Table 3. State total automobile trips.

Population Growth	Energy Future	Work-Shopping Trips Number	Work-Shopping Trips Percent	Vacation Trips Number	Vacation Trips Percent	Other Trips Number	Other Trips Percent	Total
Low	Abundant	5 579 907	59.9	146 367	1.57	3 584 013	38.5	9 310 287
	Conserved	5 214 456	60.5	136 261	1.58	3 271 416	37.9	8 622 133
	Restricted	4 788 209	63.6	112 667	1.50	2 625 848	34.9	7 526 724
Medium	Abundant	5 869 675	59.9	158 617	1.62	3 756 616	38.4	9 793 908
	Conserved	5 486 016	60.5	147 671	1.63	3 438 320	37.9	9 072 007
	Restricted	5 038 576	63.6	122 104	1.54	2 760 432	34.8	7 921 112
High	Abundant	6 080 147	59.9	168 745	1.66	3 896 532	38.4	10 145 424
	Conserved	5 683 460	60.5	157 105	1.67	3 558 894	37.9	9 399 459
	Restricted	5 220 889	63.6	129 907	1.58	2 857 804	34.8	8 208 600

pending on the road and trip characteristics. These same effects apply to the bus, rail, and air modes, but are somewhat less evident because of the much lower travel volumes for these modes. Before examining the assignments for the alternative transportation modes, a few explanations are necessary.

The bus mode is the most easily obtained alternative mode. Since bus routes need not be any more limited than automobile routes, the potential bus network is assumed to be equivalent to the highway network. Naturally, this will lead to at least a small assignment on each link, thereby subtracting some travel from the automobile mode for even very improbable bus routes. However, this is not a serious problem—the transportation planner may quickly spot the most promising bus corridors for any given future and the remaining links, which contain low bus assignments, will have very little effect on automobile travel. Future use of this process may utilize a bus network that is distinct from the highway network and accessible only at actual bus stations.

The railroad network was used for the rail mode assignments. Initially, for the northwest study, this network contained all tracks now in service, including the Mackinac Straits and Lake Michigan Ferries. Every current freight station was assumed to be a potential passenger station and rail trips were assigned to begin at the station nearest the trip origin and to continue on rail to the station nearest the trip's destination; thus access and egress times were minimum. However, since rail travel is dependent on existing tracks and train frequencies, two other factors were used. The first factor assigned a 20-min wait period at both ends of the rail trip. This excludes many short-distance trips that were assumed illogical for rail travel. The second factor compared rail access-egress times to total highway times for each trip. If the access and egress time was 30 percent or more of the highway time, the trip was not assigned to the rail mode, since few people would drive long distances to use rail service. This factor eliminated medium-distance trips that did not have good rail service available. Neither of these two restraints, however, affected the longer-distance rail trips, particularly those to and from the Upper Peninsula. Those trips contributed to large volumes on the north-south rail lines in the northwest region, which were considered unreasonable, especially since the Mackinac Ferry and other rail lines in the Upper Peninsula are unlikely to ever provide rail passenger service. This was compensated for by subtracting from all rail links any trips that use the Mackinac Ferry, which resulted in much more acceptable numbers. Elimination of other tracks that have little or no rail passenger potential and restriction of passenger stations to major towns or cities would also have been possible. Such a modification of the rail network has produced realistic passenger estimates, but also reflects some planning bias because likely passenger routes are predetermined. Using a complete rail network, a planner should be able to confirm probable passenger routes by comparisons of modal assignments for each rail corridor.

The wait time and access-egress factors used for rail were also used for air travel. The air network consists of all direct flights scheduled during July 1977. This network is restricted only by airport locations and hence is subject to frequent minor changes that are somewhat difficult to predict. It is easily possible, however, to make changes to determine the potential effects on such changes by addition or deletion of flights. Air travel characteristics are quite different from other travel modes; people will travel greater distances to airports than to other modes and will drive to major airports even though local airports provide reasonable connections. Transportation planners cannot agree about the effects of high energy costs on air travel largely because of the distinct characteristics of air travelers. Because the time savings is generally a major factor in decisions to travel by air, schedule and flight connection information is essential to estimate potential travel demand accurately. The multimodal process cannot currently use such information adequately; hence the air mode assignments are likely to be unrealistic in some cases. Given more data for present air travel, this mode could be greatly improved to better reflect actual demand. Meanwhile, air mode assignments could help determine potential air corridors if used with caution.

The plots for the rail and air modes (Figure 3) differ from automobile and bus plots in that they show the access links (i.e., the highway links used to get to and from the rail stations and airports). Comparison of automobile travel to rail and air travel is somewhat difficult since the corridors necessarily differ, and hence the paths between any zone pair may logically be radically different. For example, if one compares the assignments on the US-131 link north of Cadillac, which was numbered 3 in Figure 3, one finds the following assignments for the medium-population, abundant-energy future:

Automobile—7687 vehicle trips
Bus—470 passenger trips
Rail—764 passenger trips

It would appear unrealistic for rail trips to so greatly exceed bus trips. Even the modal split percentages would seem to contradict these futures. Only when one considers the different zone-to-zone paths and the greater flexibility of bus routes do these assignments make sense. Trips from southern Michigan north by rail have only two logical gateways, one at Cadillac and the other at Bay City. Furthermore, the rail lines through Cadillac provide the most reasonable service to the entire northwest region. Therefore, to compare bus assignments with rail assignments, one should consider all of the potential north-south bus routes that serve the area.

The multimodal process also assumes that every rail, bus, and air corridor provides equal service, and hence are equally attractive to the traveler. Obviously, this is a faulty assumption, but it should create no real problem if the transportation planner remembers that the process is designed to help locate the most feasible corridors for alternative modes and to measure the probable impact of the alternative modes on highway needs.

CONCLUSION

This paper describes a newly developed multimodal process designed to help measure the interrelated regional or statewide impacts of energy availability, population changes, and an increased emphasis on mass transit. It should help in location of potential mass transit corridors for rail, bus, and air and also evaluate the effect that such corridors could have on highway needs. Highway corridors that show grave deficiencies in all probable futures can be located by studying the travel assignments for each of the futures. Such corridors may then be assigned a high priority, and deficiencies that show in only a few of the probable futures may be assigned lower priorities.

The objective of this paper was to describe a process that enables a state or region to explore the potential diversion of different automobile trip purposes for various futures and the impact the diversion would have on transportation needs and deficiencies. The variables most often discussed by administrators, transportation planners, and citizens have been defined simply and are easily explained. This enables one to quickly and easily change desired variables and evaluate transportation needs to accurately reflect current issues. The application of the process in the northwest shows that the impacts are extremely complex. Changes in population or energy availability, for example, do not always cause uniform changes in all travel corridors. Transportation deficiencies and demands vary considerably, depending on the travel characteristics of any route.

The application of this process in the northwest region is described in detail to help show that the process is sensitive to all of the desired variables. These variables include not only the assumptions about modal selection in energy-short futures, but also population changes and general road use characteristics. Furthermore, the multimodal process uses tools previously developed for Michigan's statewide modeling system and so is completely compatible with that system. This compatibility ensures that all pertinent additions and improvements to that system will be immediately available for use in the multimodal process.

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Transportation Energy Overview: Emphasis on New York State

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This paper summarizes recent work by the New York State Department of Transportation on transportation energy analysis, consumption, and conservation. Current uses and sources of American transportation energy are reviewed. Particular emphasis is on New York. Transportation energy (gasoline, diesel, and jet fuel) comes primarily from domestic sources, Africa, and the Middle East, and is used primarily for automobiles, commercial vehicles, and air travel. New York uses a relatively higher share of transportation energy in transit and air travel than does the rest of the United States. The paper also shows gasoline use by trip purpose and location in upstate New York, describes baseline transportation energy forecasts and the importance of increased automobile fuel efficiency on conservation, and reviews public attitudes toward conservation and changes in travel behavior during the energy crisis of 1973-1974. Possible conservation actions and their potential are also summarized.

The energy crisis of 1973-1974 increased the awareness of government, industry, and the general public to the problems of energy consumption and supply. Such awareness may have been short lived [four months at most (1)]; however, for a short period of time national attention was focused on that one issue. The Arab oil embargo,